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ABSTRACT

This paper describes Fulton's (1984) developmental teaching program and the research that supports its use. It identifies the instructional procedures that seem to contribute to the program's success, and details these procedures so that teachers can adopt them for immediate use in their classrooms. An overview of the program discusses competency-based instruction and mastery learning, visual mediators (schemata), cognitive and academic skills, and direct instruction. Research on the developmental teaching program is subsequently discussed in terms of effects on academic progress, reading comprehension, and math skills. Four major elements of the program that have been shown to contribute to students' improved performance are explored: (1) the emphasis on acquisition of concepts; (2) the use of mediators, including verbal, visual, and semantic mediators, to enhance students' schema development; and (3) the use of active learning and direct instruction techniques. Implications of the concept development and cognitive skills aspects of the program for the classroom are pointed out. Concluding remarks concern issues to be resolved through further research: the efficacy of the program in promoting students' cognitive skills and the effectiveness of the program with high-achieving students. Approximately 70 references are cited. (RH)

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DEVELOPMENTAL TEACHING: A COGNITIVE APPROACH TO IMPROVING STUDENT ACHIEVEMENT

Occasional Paper 27

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INTRODUCTION

The Developmental Teaching program, designed by Joan Fulton of the Developmental Skills Institute in Richmond, Virginia, has shown extraordinary success in improving students' achievement. It seems to be especially successful with those students whom teachers often find difficult to instruct: low achievers. Moreover, these students, who typically dislike school, seem to enjoy learning when they are taught using the strategies employed in this competency-based program. This paper describes Fulton's program and the research that supports its use. It identifies the instructional procedures that seem to contribute to the program's success, and it also details these procedures so that teachers can adopt them for immediate use in their classrooms.

THE DEVELOPMENTAL TEACHING PROGRAM: AN OVERVIEW

The Developmental Teaching program combines a cognitive approach to teaching academic content with an active, engaging interaction between students and teacher. The program's effectiveness may result from its combination of these and other research-based practices in a highly systematic approach to improving students' academic and cognitive skills.

The program adopts the most defensible approach to cognitive instruction. Rather than teaching a separate sequence of cognitive skills, teachers integrate these skills with academic content. This practice is recommended by Perkins (1987), one of the most prominent researchers on cognitive instruction.

In the Developmental Teaching program, the use of one or more cognitive processes in conjunction with an academic concept (or, in Fulton's terms, "competency") is called a thinking task. Such tasks are based on four types of cognitive processes: conceptual thinking, comparison processes, transformation processes, and evaluative thinking. There are two purposes for thinking tasks. One is to ensure students' mastery of the academic competency so that they can transfer it and use it for solving unfamiliar problems. The other is to develop students' skills in using learning strategies that are applicable in many situations.

Competency-Based Instruction and Mastery Learning

One of the most important elements of the Developmental Teaching program is that, like most mastery learning and competency-based programs, it views student achievement as primarily a function of the effectiveness of instruction rather than as a function of the learner's individual characteristics. According to Fulton, learning depends on the precision of the description, or conceptual definition, that students bring to the new competency to be learned. If, for example, students have only an imprecise description of the concept (i.e., competency), they will not be able to recognize or construct examples of it; and they will not be able to solve problems requiring its application.

Some children succeed even when teachers or textbooks present new concepts in imprecise terms. These students succeed because they already possess adequate descriptions of the concepts due to their prior experiences. Previous instruction in school, independent reading, or prior learning at home may make these children able to understand concepts that are not well elaborated. Other children, particularly those who have few academic learning resources outside school, must rely on the teacher's or the textbook's presentation even when it is inadequate.

According to Fulton (1986), it is the teacher's responsibility to ensure that every child in the classroom acquires precise descriptions of the concepts being taught. This responsibility, she contends, is best accomplished through the use of visual mediators (schemata) that depict the defining attributes of the concept. All children are required to describe verbally the concept based on the visual schema their teacher presents and to use their description to perform academic tasks. This process leads to mastery of the competency.

Basic academic competencies that elementary school students need to master are identified and sequenced in the Developmental Teaching program. Using developmental teaching strategies, teachers present one competency at a time, teach a sequence of tasks related to the competency, provide for the transfer of information within the instructional process, and develop students' ability to apply the competency through thinking tasks.

Visual Mediators (Schemata)

Student mastery of the competencies is accomplished through direct instruction that begins with visual representations (mediators) of the defining attributes of all new concepts. These representations provide an organizational framework or schema for the new concept. The students are required to verbalize the defining attributes as represented in this schema before they perform the competency, that is, apply the concept.

Cognitive and Academic Skills

The Developmental Teaching program involves students in cognitive processes that reflect Bruner's (1966) concept of active learning. Unlike some cognitive teaching programs, however, the Developmental Teaching program develops these skills through their application to academic material. By this combination of methods, students are expected to master both academics and cognitive skills, such as analysis and creative problem-solving.

Research has found some instructional methods to be more effective than others in promoting students' ability to form and apply concepts. Most of these methods include active participation on the students' part. Questioning students, requiring students to form concepts inductively, and requiring students to practice applying the concepts they have just learned are all important means of concept development.

Direct Instruction

Fulton's program also uses techniques associated with direct instruction. The teacher is actively engaged with students, providing explanations and demonstrations to the group, guiding students' practice, and giving feedback. Teachers using this approach apply the following direct instruction practices to conceptual content:

- They present concepts to students in an expository format.
- They focus students' attention on pertinent attributes of the concept.
- They help students organize, encode, and retrieve information.
- They use questioning strategies to elicit responses in a recitation format.
- They provide corrective feedback to help students evaluate and improve their performance.

The program's focus on basic academic skills is also characteristic of direct instruction formats. The high level of student-teacher interaction in the Developmental Teaching program is regarded, by some of the teachers who have adopted this program, to be essential to the improved performance of low achievers.

RESEARCH ON THE DEVELOPMENTAL TEACHING PROGRAM

The success of the Developmental Teaching program has been documented in studies of elementary school-age children in kindergarten through fifth grade. As with many programs that emphasize cognitive skills, the greatest gains in the Developmental Teaching program seem to be in language arts. However, it can be used effectively in improving mathematics skills as well.

The Developmental Teaching Program: Effects on Academic Progress

One elementary school that used the Developmental Teaching program with low achievers reported a dramatic improvement in their scores after one year of instruction (Lovelace, personal communication, September 14, 1988). These students showed an increase from the 38th to the 60th percentile in language arts in the second grade, from the 29th to the 50th in the third grade, from the 38th to the 50th in the fourth, and from the 45th to the 60th in the fifth. Moreover, these students said they enjoyed learning more than they had when teachers used traditional methods. A slight drop in mathematics achievement in the fourth and fifth grades accompanied these gains in language arts.

Another study (Lowrey, personal communication, May 1988) found that all three achievement groups—low, average, and high achievers—in a fifth-grade classroom made significant gains on the SRA achievement test. After six months of instruction, the low achievers showed a gain of 3.3 years on the composite score of the SRA achievement test. Average achievers showed a gain of 2.0 years and high achievers showed a gain of 1.7 years.

When developmental teaching strategies were used with low achieving students who were repeating kindergarten, these students made better progress than other, similar students who repeated kindergarten in traditional classrooms. The experimental program emphasized language competencies but included other skills. The results showed that, on the Metropolitan Reading Readiness Test, students retained in traditional kindergarten classrooms made only a 27.9 percentile gain in achievement, whereas students in the experimental group made a 43.7 percentile gain in achievement.

The Developmental Teaching Program: Effects on Reading Comprehension

Results of a controlled study seem to confirm the effectiveness of the Developmental Teaching program and demonstrate its usefulness as a strategy to improving reading comprehension. This study includes a detailed description of the instructional process used in the Developmental Teaching program. The use of this process to teach main idea comprehension exemplifies the program's versatility.

In this study, Sherrod (1986) trained intermediate-level students to use a visual mediator (schema) combined with a verbal mediator to organize events in narrative passages. Through this process, students were better able to ascertain the main ideas of the passages.

The instructional method. Reading instruction using the Developmental Teaching program depends on a three-stage process (see Fulton, 1984, 1986). First, students are taught a concept (the concept development stage); then they use the concept to solve a problem (the thinking stage); and, finally, they generalize a way to use the concept to solve

other similar problems (the application stage).

In the concept development stage, Sherrod (1986) had students learn the concept of a fiction event. The fiction event was defined operationally as a four-part structure including: the name of the event, the name of the main character, the main actions of the main character, and the main idea conveyed through the most important actions of the main character (Sherrod, 1986, p. 64). In this structure, the main idea was conceptualized as the collective purpose of the main character's actions.

Using the developmental teaching approach, the teachers in Sherrod's study provided students with two mediators for learning the concept of a fiction event: a visual schema and a verbal mediator. Since the narratives differed, these mediators were specific to each story used in the training. The visual mediator (or schema) was a cartoon depicting the main actions of the main character in the story. The verbal mediator was a verbal description of the cartoon; it included an explanation both of the events in the story and of the function of these events within the structure of the story (Sherrod, 1986, p. 64).

In the thinking stage, students worked with a second cartoon to describe, draw, and label its event frame. Then, they compared this event frame with the one they had worked with previously. By establishing the similarities and differences between the two fiction events, the students gained an understanding of the general concept of a fiction event. They also learned to recognize the variations possible within the framework of the concept. Finally, they learned to use the fiction event (operationalized as the most important actions of the main character) to derive the main idea of the narrative.

The application stage reinforced the concept by giving students practice in constructing fiction event patterns as a way to identify the main ideas in increasingly more complicated narratives. Because there are so many different kinds of narratives that students encounter, it was important to give them practice establishing fiction event patterns in different narrative genres. Therefore, practice required students to construct fiction event patterns in folktales, legends, and short stories in order to identify the main ideas of these narratives (Sherrod, 1986, p. 65). Because of the difficulty of this application task, however, instruction was arranged in two phases: an expository instruction phase and a guided practice phase.

Two amendments to the fiction event pattern were presented when students moved from simple, straightforward narratives to more complex ones. The first amendment required students to include an additional part in the structure of the fiction event. This new part of the fiction event pattern provided a description of the purpose of each individual action in the fiction event. Students were taught to consider each of these statements when they constructed a summary statement of the collective purpose of all of the actions.

The second amendment to the fiction event pattern was the identification of the event frame in the pattern that depicted the narrative's climax or turning point. Since the action pictured in this key event frame was more decisive than other actions, it was likely to convey more information about the collective purpose of the actions. This additional step gave students a focal point within the fiction event from which to derive a statement of the collective purpose of all of the individual actions.

The results of Sherrod's study. Sherrod (1986) used a case study design with 17 intermediate-level students (ages 8-9 to 10-11) to evaluate main idea comprehension before and after instruction. The study attempted to answer six research questions:

- Was students' identification of main ideas in narrative texts significantly different before and after instruction?
- Did students' ages influence their ability to identify main ideas either before or after instruction?
- Did students' reading levels influence

their ability to identify main ideas either before or after instruction?

- Was there a significant difference between the proportion of students who made conscious use of the fiction event schema before and after instruction?

- Did the use of the fiction event schema enable more students to identify main ideas at a satisfactory level of performance?

- Did the requirement to use the complete fiction event schema enhance students' ability to identify the main idea in passages that they had previously analyzed at an unsatisfactory level of performance?

Students' identification of main ideas. The study found that after 15 hours of instruction in the use of the fiction event schema, students' identification of main ideas improved significantly. With the exception of one student whose scores were identical in both test administrations, students had posttest scores that were higher than their pretest scores.

Both the pretest and the posttest included three tasks: to find the main idea in a legend, to find the main idea in a folktale, and to find the main idea in a contemporary short story. Using a five-point rating scale, trained raters scored each student's performance of each task. A pretest score was derived by averaging the three pretest ratings; and a posttest score was derived by averaging the three posttest ratings. These averages were compared to determine the direction and significance level of their difference.

On average, students had pretest scores of 1.578; their average posttest score was 2.735. Using the Wilcoxon matched-pairs, signed-ranks test, Sherrod (1986, pp. 87-88) found that students' pretest ratings were significantly lower than their posttest ratings. This difference was significant at the .005 level.

The influence of age and reading level. Sherrod found that, within the age range of the students whom she studied, age had no significant bearing on students' identification of main ideas. The correlation between age and pretest ratings was -.11; between age and posttest ratings, the correlation was .46.

She also found that reading level did not correlate significantly with students' pretest performance. On the other hand, Sherrod found a significant positive correlation between reading level and posttest ratings. Students with higher reading levels seemed to derive more benefit from instruction in the use of the fiction event schema than did students with lower reading levels. This finding may be misleading, however. The effect may relate more to the length of the intervention (i.e., 15 hours) than to its effectiveness with less capable readers. With more training in the use of fiction event schema, these readers might have made larger gains.

Conscious use of fiction event schema. To determine the learning strategies that students used to identify the main ideas in passages, Sherrod arranged for each student to be interviewed following completion of the pretest and then, again, following completion of the posttest. The purpose of the interview was to ascertain the degree to which students used the fiction event schema or some other mediator.

Interviewers coded students' answers as belonging to one of the following five categories:

- explicitly stated complete use of the fiction event schema,

- implicitly stated complete use of the fiction event schema,

- partial use of the fiction event schema,

- use of some other strategy, and

- no strategy reported (Sherrod, 1986, p. 89).

The percentage of students using the fiction event schema, either completely or

partially, was computed for both the pretest and the posttest. According to Sherrod (1986, p. 90), the "data suggested that conscious use—complete or partial—of the fiction event schema did occur during pretest but was more clearly in evidence during posttest." By using McNemar's Test of Equality of Correlated Proportions, Sherrod was able to show that the instructional strategy significantly influenced the likelihood that a student would consciously use the fiction event schema as a cognitive learning strategy to identify main ideas.

Level of performance. To measure the relationship between the use of the fiction event schema and satisfactory identification of main ideas in the posttest, Sherrod used a chi-square test. She determined that a score of 3.0 or better on the five-point rating scale would constitute an acceptable level of performance and that either partial use or complete use of the fiction event schema would represent use of this learning strategy. Her findings were significant at the .025 level: the conscious use of the fiction event schema was related to satisfactory performance of the task.

Further analysis showed that the two students who reported complete use of the schema had a higher average rating (3.42) than the ten students who reported partial use of the schema (3.0). In turn, those who reported partial use of the schema had average ratings that were higher than those who reported that they did not use the schema at all. The five students who did not use the schema had average posttest ratings of 1.93.

Prompted use of the fiction event schema. Sherrod found that, even on the posttest, most students did not use the complete fiction event schema. Since previous findings indicated the use of the schema related to improvements in identification of main ideas, Sherrod decided to readminister the posttest under different conditions. In this second administration of the posttest, teachers provided students with a fiction event pattern and told them to use it in analyzing each narrative passage.

Sherrod then compared each student's performance on the two posttests. She was most interested in seeing the effect of the prompted use of the schema on main idea identification for the passage with the lowest score on the first posttest. Using a Wilcoxon matched-pairs, signed-ranks test, she compared each student's score on the passage with the lowest rating on the first posttest with his or her score on the same passage on the second posttest. This comparison indicated that students' second attempt to identify the main event in the same passage was improved significantly by the prompted use of the fiction event schema. Whereas the average rating for the lowest-rated passage on the first posttest was 2.26, the average rating for the same passage on the second posttest was 3.91. This positive difference was significant at the .005 level.

Implications and limitations of the study. The study showed the value of the Developmental Teaching program for improving students' comprehension of the main idea in fictional narratives. It provided important groundwork for further research because of the following considerations:

- Few methods have been successful in enabling students to transfer the learning strategies that they have developed through direct instruction to reading tasks that require them to apply these strategies independently (Tierney and Cunningham, 1984; but cf. Duffy, et al., 1987). The Developmental Teaching program, however, seems to make this type of transfer possible.

- Both verbal mediation strategies and visual mediation strategies are effective in improving students' reading comprehension. Programs that include both types of mediation show stronger effects (see Baumann, 1984, 1986; Noll, 1983).

- Identifying the main ideas of passages is a skill that is central to the

process of literal comprehension (Beck, McKeown, McCaslin, and Burkes, 1979; Turner, 1988). Acquisition of this skill makes it easier for students to perform other comprehension tasks such as recalling the important events in stories and drawing correct inferences from the information given (Alvarez, 1983; Reder and Anderson, 1980).

- Poor readers are less successful than good readers in identifying main ideas in passages. Strategies that help poor readers learn to identify main ideas improve such students' reading comprehension and memory (Winograd and Bridges, 1986). The Developmental Teaching program uses strategies that are especially appropriate for less capable readers.

Although the findings of Sherrod's study are statistically significant and have important ramifications, they need to be interpreted with caution. The study was intended as preliminary work in a new field of inquiry. Neither its methods nor its sample was selected to produce results that could be generalized. Further investigation using experimental or quasi-experimental methods and larger samples will be necessary in order to substantiate the effectiveness of the Developmental Teaching program for improving students' reading comprehension.

The Developmental Teaching Program: Effects on Math Skills

Another study investigated students' acquisitions of specific math skills consequent to instruction with developmental teaching strategies. This study researched the effect of schema-based instructional strategies on the rounding number skills of low-achieving fifth-grade students.

Rounding numbers. Hopkins' (1987) study of 42 low-achieving fifth graders investigated the effects of the schema-based instructional strategy on students' mastery and verbalization of the mathematical operations used in rounding whole numbers. Students randomly assigned to the treatment and control groups were provided with two 50-minute periods of instruction followed by a daily 30-minute practice period on each of the next three days.

The treatment group was taught using Fulton's schema-based approach. The control group was taught through the traditional textbook method. Students' learning was measured on two instruments: a 20-item achievement test on rounding numbers, and a structured interview soliciting subjects' verbal descriptions of the procedures that are used in rounding whole numbers.

The students in the experimental group outperformed the control group on both mastery and verbalization of rounding numbers. Eighteen of the 21 students in the experimental group achieved mastery, defined as a score of at least 90 percent on the 20-item rounding numbers test. Only nine of the 21 control group students mastered the rounding number process.

All of the students in the experimental group met the criteria for successfully verbalizing the process, whereas only five of the control group students met those criteria. Answers to the question—"How would you tell somebody how to round numbers?"—showed how students verbalized the rounding numbers process. The following quotations are typical of the responses in each group (Hopkins, 1987, p. 93):

> **Sample Experimental Student Response:**
> Do all the steps: First you locate the place number and look to the right. If it is less than 5 you cross it out, put zero at the top, and if it's greater than 5 you add one to it (place number).
>
> **Sample Control Student Response:**
> I would tell them to draw a number line to help them out.

Not only did the experimental group

students give detailed descriptions immediately after instruction, they also retained the conceptual knowledge. A followup study showed that all of the 15 experimental group students available for study could still verbalize the process four weeks later.

This study found that students who were taught using Fulton's schema-based instructional strategy tended to be more successful than students taught using traditional textbook methods. They achieved greater success both in mastering the task and in verbalizing the steps for rounding whole numbers. These findings suggest that the use of a visual mediator that defines the distinguishing attributes of a concept and presents these attributes in a pattern may facilitate students' construction of an internal schema. Once acquired, the students' schema for rounding whole numbers seems to aid their recall and their performance of the task.

RESEARCH CONTEXT

It is impossible to pinpoint the factors that contribute most to the effectiveness of the Developmental Teaching program without further experimental research. Four major elements of the program, however, are derived from established theory. When studied separately, each of these elements has been shown to contribute to students' improved performance. The four elements are the emphasis on acquisition of concepts, the use of mediators to enhance students' schema development, the provision of active learning experiences to facilitate transfer of concepts and skills, and the use of direct instruction techniques.

Concept Development

Fulton's program is unique among the recently developed programs that purport to teach thinking skills. It emphasizes the importance of **how** concepts are presented, as well as describing processes that foster students' application of concepts. In many ways, however, the program employs instructional practices based on long-established educational theory.

The two main educational perspectives on concept development are cognitive and behavioral. Cognitive psychologists, like Piaget, focus on the construction of internal representations or concepts as the basis of human intellectual development. Behavioral psychologists emphasize the acquisition of behavioral repertoires (e.g., chains of overt responses to stimuli). Behaviorists claim that such repertoires are developed by the association of particular consequences with certain stimuli or behaviors. Cognitive psychologists, on the other hand, postulate an interaction between innate mental categories or predispositions and environmental conditions. In a broad sense the behavioral view describes a process of habituation, while the cognitive view describes a process of interaction. According to cognitive psychologists, human cognition plays an active role in structuring learning rather than a passive role in receiving information.

Behavioral and cognitive views converge in Fulton's approach to instruction. Her approach resembles that recommended by Bruner (1966). According to Bruner, learners do construct internal representations, but these come from reinforcement by environmental events rather than from preexisting mental dispositions. He suggests several principles of learning (Bruner, 1966, pp. 5-6, passim):

- Growth is characterized by increasing independence of response from the immediate nature of the stimulus.
- Growth depends upon internalizing events into a "storage system" that corresponds to the environment.
- Intellectual growth involves an increasing capacity to say to oneself and others, by means of words or symbols, what one has done or what one will do.
- Intellectual development depends upon a systematic and contingent interaction between a tutor and a learner.
- Teaching is vastly facilitated by the medium of language, which ends by being not only the medium for exchange but the instrument that the learner can then use himself in bringing order into the environment.
- Intellectual development is marked by increasing the capacity to deal with several alternatives simultaneously, to tend to several sequences during the same period of time, and

to allocate time and attention in a manner appropriate to these multiple demands.

These principles are so similar to those inherent in Fulton's program that they could almost serve as a blueprint for her instructional approach. From among these principles, Fulton stresses two as most critical for concept development: providing adequate information to allow students to develop a "storage system" that is veridical with the environment, and encouraging verbalization as a mediating factor. Successful implementation of these principles depends on a continuing interaction between the student and teacher.

Conceptual modes. Bruner's instructional theory relies on the notion that there are different modes of cognition. In this way, his work reflects the stage theory originated by Jean Piaget.

Piaget's developmental stages, ranging from sensorimotor to formal operations, describe different ways of conceiving the world. The early, motor schemata inform later iconic and symbolic modes of conception. Bruner's theory also sees the physical, or enactive mode, as more basic than iconic and symbolic ones. Even though Piaget and Bruner's categories are not strictly analogous, they have much in common. Both provide theoretical support for approaches to cognitive instruction that emphasize students' conceptual development.

According to some psychologists, the enactive mode continues to serve, in analogical form, as a basis for students' understanding of abstract and formal material. Graphic representation more closely resembles physical action than does verbal representation. For this reason, visual mediators may facilitate learning of ideas that are usually represented verbally (Hart, 1975). This view may explain the convention of using diagrammatic models to elucidate abstract theories. Some support for this view is also found in the prevalence of spatial, tactile, and visual metaphors in verbal discourse.

Defining attributes. One of the problems in acquiring a concept is to determine what features are essential to it. Almost all nonmathematical concepts have "fuzzy boundaries." This is a reflection of the fact that some features are more relevant than others in distinguishing one concept from another. For example, a swallow is more "bird-like" than an ostrich because most birds are small. To categorize an animal or bird, size is not so essential as the presence of wings and a beak; but, nonetheless, smallness is a feature of most animals that we call "birds."

Precise definitions neither overextend nor underextend the boundaries of the concept in question. It is characteristic of young children's language that their semantic concepts do both at first. As Bjorklund (1989) notes, children may overextend the use of a new word, such as using "doggy" to refer to all animals with four legs. Or, they may underextend it and use the term only in reference to their own pet. This phenomenon occurs because young children have not yet learned all of the features or attributes that are relevant to the concept.

In learning a new academic concept, students must learn the defining features of the concept. Otherwise, they will overextend or underextend the concept when they try to use it in practice and problem-solving activities. For example, if students who are learning the concept, "compound sentence," know only that it is made up of words, starts with a capital letter, contains a conjunction, and ends with a period, they will invariably **overextend** the concept. Given the assignment to distinguish compound sentences from among various sentence types, they will not be able to differentiate compound sentences from a simple sentence or from complex sentences. If, on the other hand, they believe that the salient feature of a compound sentence is that it contains a conjunction, they will **underextend** the concept. In this case, they will fail to identify those compound sentences that are joined by a semicolon rather than a conjunction. In order to learn the concept, they must learn all of the essential features and their variant forms.

Teachers sometimes neglect to provide a definition that is sufficiently precise to prevent students' over- or underextending the concept. Textbooks, too, sometimes fail to identify all of the relevant features of a concept. According to Fulton, most teachers do not spend sufficient time or provide careful enough instructional sequences to enable students to acquire precise definitions of concepts.

Even when a teacher does provide a precise definition, many children may fail to understand it because they do not have the conceptual framework (schema) necessary to process the definition. For example, students probably need to understand the concepts, "subject," "verb," and "sentence," before they can develop the concept, "compound sentence." In general, the more concepts a student knows, the more readily he or she will be able to learn new concepts.

Schematic Presentation of Concepts

One of the best ways to improve students' learning of concepts is to help them encode new information. Through this process, students relate new information to preexisting knowledge. At this stage, a teacher can frame information within a structure that enables the students to code the information in meaningful ways. The more meaning that is attributed to a new idea when it is first learned, the more likely it is to be remembered and retrieved. In addition, meaningful learning serves as a strong basis for new learning. Hence, students who learn concepts by processing them "deeply" are better able than other students to use those concepts as a foundation for future learning (Glover, Plake, and Roberts, 1981).

The process of providing students with a cognitive structure for encoding new information or conceptual knowledge is called **mediation**. Three kinds of mediators can be used: verbal, visual, or semantic mediators. These mediators structure the information students receive through the three sensory registers that are most relevant to conceptual learning (Child, 1986).

Verbal Mediators

By having students state the definitions of new concepts, the Developmental Teaching program requires them to use a verbal mediation strategy. Verbal mediation strategies help students attach meaning to new information and, hence, encode and retrieve the information more readily.

According to some theorists (e.g., Anderson and Bower, 1973; Norman and Rumelhart, 1975), each unit of verbal information (e.g., the definition of a concept) is encoded, stored, and retrieved as a set of propositions. Each proposition contains the concept and the subject-predicate relationship by which the concept is described (Gagne, 1985). For example, the concept, "dog," may be encoded through the proposition, "a dog barks." It is also encoded through other propositions such as, "a dog has fur," and "a dog wags its tail." The specific propositions that a particular individual uses for encoding information depends on his or her experiences with respect to the concept.

Related propositions are stored in cognitive networks that are linked together with other networks. The more networks to which a particular proposition is linked, the more easily it will be retrieved. Mediators help students encode verbal information by assisting them in the formulation of meaningful propositions that can be rehearsed and recalled. Verbal mediators are most effective when they are distinctive and when they establish relationships between the new information and preexisting knowledge (Gagne, 1985).

Feuerstein et al. (1981) and Feuerstein, Rand, Hoffman, and Miller (1979) emphasize the importance of mediated learning. These researchers claim that mediated learning is necessary for normal cognitive development. Children who lack mediated learning experiences do not develop sufficient cognitive modifiability.

Their learning rate is slower than average, and their cognitive development is delayed. According to Feuerstein, however, children's thinking processes can be improved by the use of an intervention program that provides verbal mediation. A considerable body of research with elementary and secondary students supports this claim (Savell, Twohig, and Rachford, 1986).

Teachers can encourage students to use verbal mediation strategies by incorporating advance organizers or thematic organizers into instructional sequences. Verbal mediation also is accomplished during class discussions through the use of hierarchically-arranged questions that promote inductive or deductive thinking (see Taba, 1966). Descriptions of the two less familiar strategies—advance organizers and thematic organizers—are presented below.

Advance organizers. One verbal mediation technique involves the use of advance organizers (Ausubel, 1978). These brief oral or written statements provide an overview of the material that is about to be presented. They are, however, more general and more abstract than the material itself. As Devine (1986, p. 86) notes, advance organizers "provide ideational scaffolding for the incorporation of the new material." In this way, they help students form a bridge between what they already know and what they are about to learn.

Research studies on the use of advance organizers have not yielded clear conclusions (Tierney and Cunningham, 1984). Whereas some research supports the use of this strategy, other research is less positive (Luiten, Ames, and Ackerson, 1980; Vick and Lynn, 1983). Using a metaanalysis technique, Luiten, Ames, and Ackerson (1980) studied the effects of advance organizers on students' learning. They concluded that—in all grade levels, subject areas, and presentation modes—advance organizers had a small but positive effect on students' performance and on their retention of material. They also found that advance organizers were more effective with good readers than with poor readers.

Mayer (1979, 1984) concluded that advance organizers are helpful if they are used appropriately. In many studies, however, advance organizers are not used or evaluated under proper conditions (Vick and Lynn, 1983). According to Mayer (1979), advance organizers are most effective when they meet two conditions: when they elaborate material that is new to the students, and when they present connections between the material and students' previous knowledge. Such connections are important because they make the new ideas more cohesive and, therefore, more comprehensible.

Thematic organizers. Like advance organizers, thematic organizers provide verbal mediation before students encounter new material (Alvarez, 1983). Thematic organizers, however, differ from advance organizers in two ways. First, they are written on a level commensurate with the students' reading level; they are neither as abstract nor as theoretical as advance organizers. Second, they provide specific, relevant information about the topic. Whereas advance organizers focus attention on broad generalities that undergird the concept that will be presented, thematic organizers emphasize the most important information.

According to Risko and Alvarez (1986, p. 300), thematic organizers are both systematic and explicit in their presentation of the central theme of a text. Thematic organizers also relate the theme of the passage directly to students' prior experiences and knowledge. Perhaps these characteristics of thematic organizers explain their effectiveness with less capable readers (Risko and Alvarez, 1986).

Visual Mediators

One characteristic of the Developmental Teaching program is its use of visual mediators (or graphic organizers) to represent concepts schematically. Fulton (1986) affirms the consensus of many cognitive psychologists (see Paivio, 1971) when she maintains that visual

mediators organize information in ways that enable students to remember and retrieve it. Theoretically, the use of visual mediators is based on three premises: that the mind organizes information in networks (schemata) that change in response to new experiences (see Rumelhart, 1980), that schemata enable individuals to recognize and make sense out of new information (McNeil, 1987), and that visual representations help students relate new information to existing schemata (Paivio, 1971).

In spite of the strong theoretical basis for using visual mediators, research support has not been overwhelmingly positive. A metaanalysis conducted by Moore and Readence (1984) showed an average effect size of .22 for the use of graphic organizers to help students comprehend textual materials. According to these authors, however, various conditions influenced the effectiveness of this instructional strategy. For example, graphic organizers used **after** students read the text (i.e., graphic post organizers) were more effective than those used **before** the students read the text (i.e., advance organizers). In addition, graphic organizers seemed to have a more positive influence on students' vocabulary knowledge than on their general comprehension of textual material.

Alvermann and Boothby (1984) demonstrated that the length of training in the use of graphic organizers to improve comprehension and recall was a key factor in the effectiveness of the treatment. In their study, students who received seven days of training performed no better than students in the control group. By contrast, those who received 14 days of training significantly outperformed the control group on both comprehension and recall tasks.

As this research suggests, graphic organizers have a positive—though limited—effect on students' comprehension of textual materials. For this reason, teachers may want to use graphic organizers as one of several ways to help students organize the ideas presented in reading assignments. Visual mediators of this sort also may make it easier for students to organize the information presented through other expository formats such as lectures, filmstrips, and videotapes. Two kinds of graphic organizers are particularly applicable: structured overviews and restructured text.

Structured overviews. According to Devine (1986), structured overviews present visual summaries of the concepts and relationships presented in textual material. Originally, this type of graphic organizer was intended as a preview of the material to be presented; however, more recent work suggests that a structured overview might be more effective as a way to summarize material after it has been presented (Moore and Readence, 1984).

Like an outline, a structured overview uses key words to identify the most important concepts in a reading passage or lecture. Unlike an outline, however, a structured overview organizes the information conceptually rather than sequentially. An example of this difference is presented in **Figure 1**, where an outline of the concept "family" is contrasted with a structured overview of the same concept.

Restructured text. This type of graphic organizer is used after students read a text passage or hear a lecture. It enables students to reconceptualize the ideas so that they fit into an organizing structure. By using the "top-level" structure, students are better able to comprehend and recall information from the passage or lecture (Meyer, 1982).

Textbooks and speakers present information sequentially. Even when they are trying to make comparisons or describe causes and their effects, authors and speakers must proceed in a point-by-point fashion. Like a structured overview, a restructured text reframes a sequential, expository presentation in a way that highlights its key relationships. Restructuring an expository presentation helps students focus attention on the purpose of the exposition and on the points that support this purpose. Restructuring text passages or lectures on the basis of two or more organizing patterns gives students several perspec-

Outline Presenting the Concept, "Family"

I. Purposes of the Family
   A. Child Rearing
   B. Economic
      1. self-sufficiency
      2. division of labor
   C. Cultural Transmission

II. Types of Families
   A. Nuclear
   B. Extended

III. Roles in Family
   A. Parent
      1. father
      2. mother
   B. Child
      1. sister
      2. brother

Structured Overview Presenting the Concept, "Family"

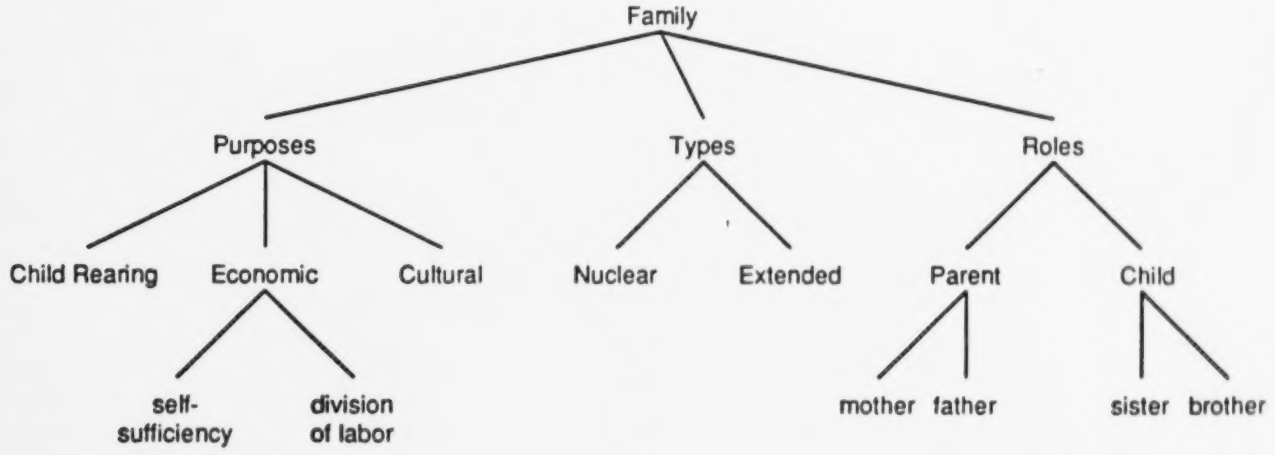

Figure 1
The Contrast Between an Outline and a Structured Overview

tives from which to analyze the complexity of the ideas presented.

Semantic Mediators

The schematics used in the Developmental Teaching program might more properly be classified as semantic mediators than as visual mediators. The distinction between these two types of mediators is subtle. Whereas visual mediators emphasize the structure of the information that an author or lecturer presents, semantic mediators emphasize the structure of concepts and their relationships to other concepts. Semantic mediators focus on the salient characteristics of concepts: their relationships to subordinate and superordinate concepts, their attributes, and their exemplars (Pearson and Johnson, 1978). In this way, semantic mediators relate visual schematics to verbal propositions. Because of this association of verbal and visual representations of concepts, semantic mediators are more likely than visual mediators to activate students' prior knowledge (Stahl and Vancil, 1986). Effective use of semantic mediators, therefore, entails both a presentation of the schematic and a discussion of it.

Two types of semantic mediation are semantic mapping and semantic features analysis. Each of these techniques is discussed below.

Semantic mapping. According to McNeil (1987), a semantic map links new concepts to both abstract schemata and concrete examples. The semantic map locates a new concept within a hierarchy that is constructed of subordinate, superordinate, and coordinate concepts. Semantic maps are often used before students read an unfamiliar text passage in order to acquaint them with the meanings of new vocabulary words. They can also be used to give students a preview of the concepts that will be presented through other expository formats.

To guide a group of students in the process of constructing a semantic map for a concept, the teacher should use the following procedures:

- Ask students to describe everything that comes to mind when they think of a particular object. List these characteristics on the chalkboard.
- Group similar characteristics into categories.
- Have students label the categories. Give them assistance if they have trouble assigning good labels to the categories.
- Talk with the students about the categories and the characteristics subsumed under each.
- Ask students to read the passage, listen to the lecture, or view the film.
- Redirect students' attention to the semantic map. Have them add ideas that they gained through their reading, listening, or viewing. Ask them to correct any errors on the original map.

Semantic mapping is a versatile technique. Simple maps can be constructed to demonstrate the salient features of a concept; and more complex maps can be constructed to demonstrate the various ways in which a concept relates to other concepts. One format for a simple semantic map is presented in **Figure 2**. A more complex semantic map, detailing the complexities of the concept, "family," is depicted in **Figure 3**.

Semantic features analysis. Using this technique, a teacher guides students in the process of listing a concept's features. The purpose of the activity is to identify the salient characteristics of the concept, as well as to distinguish it from other related concepts (see Smith, Shoben, and Rips, 1974). It is particularly applicable whenever a teacher wants to present concepts that implicate several related subordinate concepts. Teachers may want to use this technique when presenting new vocabulary at the beginning of reading lessons. It has also been recommended for teaching concepts in mathematics (Stieglitz and Stieglitz,

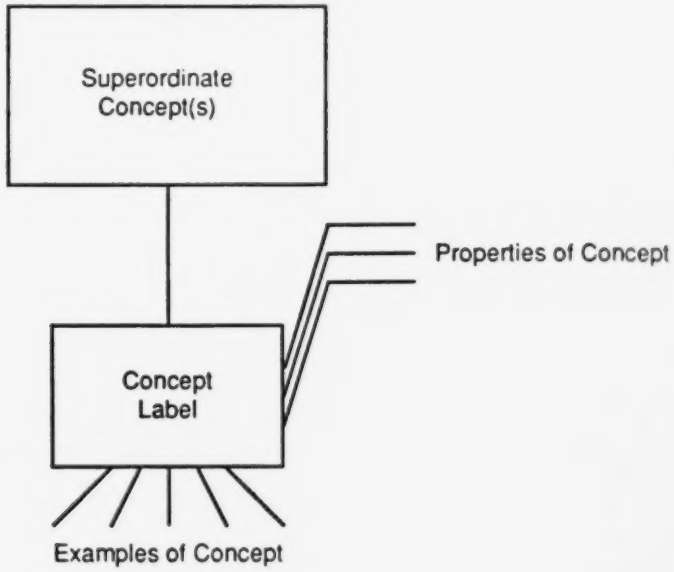

Figure 2
Simple Format for a Semantic Map

1981) and in social studies (Johnson, Toms-Bronowski, and Pittleman, 1981).

McNeil (1987, pp. 112, 114) presents a concise list of instructions for using this technique. His list is paraphrased in the following steps:

- Identify the concept.
- In a column, list examples of the concept.
- In a row, list features shared by some of the examples.
- Construct a matrix with cells that show the intersection of each row and each column.
- Guide students as they put pluses and minuses in the matrix to show whether or not each example in the column has each feature listed in the row.
- Allow students to add examples and features as they proceed.

Figure 4 shows an abbreviated version of a semantic features analysis for the concept, "food."

Active Learning

Active learning is important for improving students' recall of concepts and their ability to transfer concepts (i.e., use them to solve many different and complex problems). These instructional goals are best accomplished by starting with lower-order thinking tasks and moving to higher-order ones.

Fulton's program, with its emphasis on basic skills, makes this progression. By forging connections between factual recall, comprehension, and application, the program teaches students specific processes (or strategies) for solving

problems.

Recent programs for developing cognitive skills devote more attention to higher-order than to lower-order processes. Such an emphasis, however, may be ill-advised, particularly for elementary school students and low achievers. Because they are not yet formal operational thinkers, these students may not process concepts "deeply." They may need considerable practice with lower-order tasks in order to gain a firm understanding of concepts. Active learning provides an instructional framework in which students can learn concepts even at a concrete level. The Developmental Teaching program provides just such a framework.

Direct Instruction

Like many competency-based programs, the Developmental Teaching program relies on principles of direct instruction. Foremost among these principles is the requirement that teachers take responsibility for students' learning (Murphy, Weil, and McGreal, 1986; Zahorik and Kritek, 1980). According to this view, learning results from effective instruction rather than from students' characteristics (e.g., ability or motivation). Programs of direct instruction, therefore, require teachers to structure lessons in ways that enable students to learn (Murphy, Weil, and McGreal,

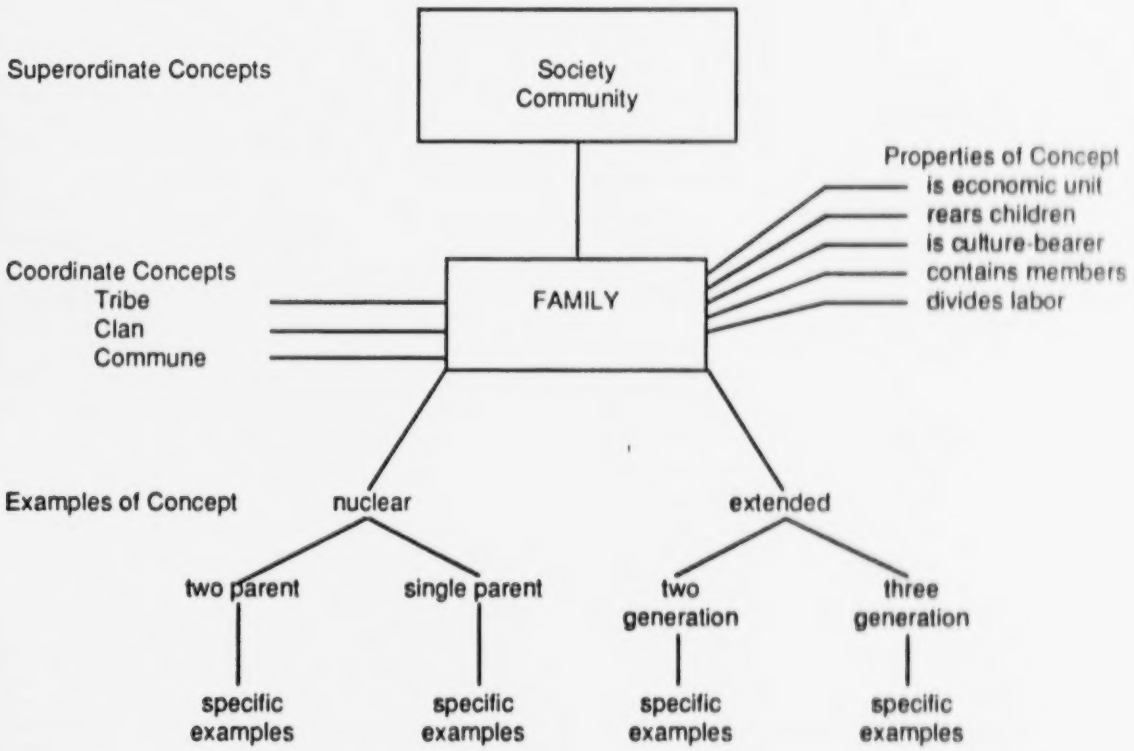

Figure 3
More Complex Semantic Map of the Concept, "Family"

Examples	Features						
	sweet	salty	sour	bitter	has protein	has fat	has carbohydrates
eggs	-	-	-	-	+	+	-
steak	-	-	-	-	+	+	-
apple	+	-	-	-	-	-	+
rice	-	-	-	-	+	-	+
pickle	-	+	+	-	-	-	+
cake	+	-	-	-	+	+	+

Figure 4
Semantic Features Analysis for the Concept, "Food"

1986; Rosenshine, 1983).

Rosenshine (1979, p. 38) describes those classrooms in which direct instruction is used as "academically focused, teacher-directed classrooms using sequenced and structured materials." According to Rosenshine (1979), direct instruction within these classrooms is characterized by certain types of teaching activities. These are:

> ...teaching activities where goals are clear to students, time allotted for instruction is sufficient and continous, coverage of content is extensive, the performance of students is monitored, questions are at a low cognitive level so that students can produce many correct responses, and feedback to students is immediate and academically oriented (Rosenshine, 1979, p. 38).

As this description implies, direct instruction is particularly suited to instruction in basic skills (e.g., Baumann, 1986; Gersten and Carnine, 1984; Good and Grouws, 1979). For this reason, direct instruction is often recommended as a procedure of benefit to handicapped students and other students at risk of academic failure (e.g., Meyer, 1983; Polloway, Epstein, Polloway, Patton, and Ball, 1986). Recent research, however, also documented the effectiveness of direct instruction for teaching more complex skills and content (e.g., Baumann, 1984; Cramer, 1985; Fitzgerald and Markham, 1987).

According to Darch, Carnine, and Gersten (1983), two instructional sequences characterize direct instruction: those relating to **development** (i.e., the teacher's presentation of new content) and those relating to **practice** (i.e., students' review of new content for the purpose of achieving mastery). These researchers found that, without special training, teachers prepared development sequences that were less effective than their practice sequences. This finding supports Fulton's (1986) claim that, in order to promote students' mastery of competencies, teachers need to use a predetermined sequence of steps during the expository phase of instruction.

Direct instruction is a method that combines the procedures used in effective classrooms (i.e., those characterized by high student achievement) into a coherent instructional sequence (Zahorik and Kritek, 1980). Teachers who wish to use direct instruction should, therefore, be familiar with each of the procedures in the sequence. To better clarify the nature of these procedures, the discussion below will first describe those related to the

development (or expository) phase of instruction and then will describe those related to the practice phase of instruction.

The development (expository) phase. According to Murphy, Weil, and McGreal (1986), teachers engage in two types of activity during the development phase. First, they establish a framework that focuses students' attention and prepares them for the lesson. Second, they interact with students to explicate the new skill or concept.

During the first of these activities, teachers state the objectives of the lesson, identify the content to be learned, relate the new content to students' previous experiences, and explain the procedures of the lesson. Murphy, Weil, and McGreal (1986, p. 87) provide a list of the introductory teaching activities that have been positively correlated with students' achievement. These are:

- organizing learning materials in advance of instruction;
- providing clear, explicit instructions about work to be done;
- describing the materials and procedures students will use during the lesson;
- administering pretests;
- presenting or discussing the objectives of the lesson;
- providing an overview of the lesson; and
- relating new material to students' preexisting knowledge.

After introducing lessons, teachers begin actual instruction. Typically, they explain, demonstrate, and model new skills or concepts. In order to assure that students have learned what is presented, teachers ask them questions throughout this part of the instructional sequence. These questions constitute recitation, the practice of asking many factual recall questions to develop or reiterate initial instruction (Gagne, 1985). During recitation, teachers use questioning strategies that produce a high rate of student success (Murphy, Weil, and McGreal, 1986).

Teachers who use direct instruction also respond to students' answers in characteristic ways. They give students sufficient time to answer questions (Gall, 1984), rephrase questions to get more complete or appropriate answers (Anderson, Evertson, and Brophy, 1979), and provide corrective feedback and contingent praise (Brophy, 1981).

The practicing phase. In most direct instruction programs, students are provided with two types of practice: guided practice and independent practice (see Hunter, 1981; Murphy, Weil, and McGreal, 1986). These practice experiences are critical to students' mastery of new skills or concepts (Rosenshine, 1976). According to Zahorik and Kritek (1980), however, many teachers do not use practice activities in ways that promote students' achievement.

During guided practice, teachers should assign seat work or group work to students and monitor their performance. When they see errors in students' work, teachers should point them out and show students the correct way to perform the task. If many students appear to be having difficulty with the same concept or skill, teachers should return to the development phase of instruction.

Independent practice gives students the opportunity to become fluent with newly-acquired knowledge. Teachers should assign tasks for independent practice only when they are sure that students have a firm grasp of the skill or concept. In this way, students' practice will reinforce correct performance of the skill or application of the concept. In some cases, students' performance at this phase will indicate their need for additional instruction. However, once students have engaged in independent practice activities, they may have a difficult time modifying their performance. Reteaching may require students to unlearn incorrect procedures and relearn correct ones.

IMPLICATIONS FOR THE CLASSROOM

Implementing the Developmental Teaching program requires training in the philosophy, the strategies, and the specific procedures that were designed by Fulton (1986). However, many of the elements of the program are basic to effective teaching and lend themselves to adoption in any classroom. First, and perhaps foremost, is the emphasis on teachers' acceptance of their responsibility for students' successes and failures. This acceptance forms the rationale for the careful planning and systematic implementation of the instructional strategies used in the program. Such strategies enable students to acquire the concepts and skills they need in order to master the academic subjects taught in school.

Developmental Teaching Strategies: Concept Development

A crucial element of the program—and another element that can be adopted by any teacher—is the emphasis given to the presentation of new concepts. As noted earlier, a basic premise of Fulton's program is that learning depends on the precision of the conceptual description that the student uses to perform a new competency. In the Development Teaching program, the students' basic tasks are ones of description and performance. Concept development strategies result in students' ability to describe the concept.

General procedures. At the beginning of the instructional sequence, the teacher presents each concept and identifies its distinguishing features. This presentation is both verbal and visual. The visual presentation, or schema, is a diagrammatic representation of the concept. It depicts the concept, its attributes or parts, and the relationship between them. If the concept is a category, the visual representation is a semantic map. If the concept is a skill, for example, "analysis," the visual representation, called a skill lattice, shows the subskills.

Developmental teaching strategies emphasize the teaching of precise descriptions of concepts. The distinguishing attributes and examples are represented visually as a pattern or structure that organizes the information so that students can readily recall it. This structure also helps the students perform tasks that require application of the concept. This procedure is especially effective with low achievers, whose attention sometimes wanders during instruction because they lack understanding of the concepts being presented. By ensuring that all students have grasped each concept, this method makes it likely that even low achievers will stay on task during practice and application activities.

Before students perform tasks using the concepts, they are required to give oral or written descriptions of the concept. Their descriptions are based on the schematic presentation provided by the teacher. These required verbalizations serve as learning mediators. Such mediators assist students with the process of encoding and memorizing the concept and, perhaps, with its application. These mediators apparently aid in the retrieval of the concept and, thus, enable the students to perform application tasks more successfully.

Procedures for concept formation. The first step in concept formation is the teacher's introduction of the concept. At this stage, the teacher also provides examples of the concept. Even during this presentation stage, the students are actively involved. The teacher asks students to identify or differentiate between examples of the concept. For instance, the teacher may ask students to

select one example of the concept out of several possible examples or to group examples that belong together.

In the second step, the teacher shows students the visual representation of the concept. Because the students might fail to notice all of the concept's features, the teacher guides the students by giving them a verbal description of the visual representation. Then, the teacher asks the students to copy the representation and label its parts.

Next, the teacher assists students in drawing and labeling an example of the concept. The students look at their general visual representation in order to draw and label the parts of the example.

Finally, the teacher guides the students' verbal descriptions of the example. During this process, the students and teacher discuss the features of their drawings.

Procedures for concept construction. During the concept construction phase, students engage in activities that enable them to form a mental construct of the concept. This mental construct allows students to recall the concept whenever they need it to solve problems. The following steps in the instructional sequence help students acquire a concept that they can recall instantaneously.

First, the teacher provides another example of the concept. The students identify the parts of the second example by recalling parts of the visual representation or parts of the first example. Those students who cannot recall the information are told to refer to their copy of the visual representation. Then, the teacher asks the students to draw and label the parts of the second example and to describe it. Again, the teacher and students discuss each part of the example.

During this process, the teacher helps students identify the distinguishing attributes of the concept that appear in the examples. The teacher also requires students to compare the two examples by asking what is similar about them. This question elicits students' recall of the defining attributes of the concept. Next, the teacher asks about differences between the two examples. This question stimulates students to identify nondefining attributes. At the conclusion of the concept construction stage, each student should have internalized a precise description of the concept.

Procedures for identifying concept dimensions. The concept dimensions strategy is used to teach concepts that have members or types rather than parts. A pronoun, for example, doesn't have parts; but there are three different types of pronouns: demonstrative, indefinite, and personal. This kind of concept might be presented schematically by using a semantic map such as the one presented in **Figure 5**. Students use this type of schema to help categorize different pronouns.

The first step of the concept dimensions strategy is the teacher's introduction of the concept that includes a description of the differences among examples based on their types. Students then draw and label their own copy of the schematic.

After the students have drawn and labeled the framework of the schematic, the teacher gives them a list of examples to sort. So students can check their work, the teacher draws the schema and writes the examples on the board. Then, the teacher guides the students through a description of the distinguishing attributes of the concept based on the examples.

Procedures for the skills lattice strategy. This strategy is used to teach a skill through its subskills. The visual representation consists of the concept and the subskills or subcomponents associated with it. The distinguishing attributes of the concept are the same as the subskills. Students use the visual representation to sort examples of the concept into appropriate subskill categories.

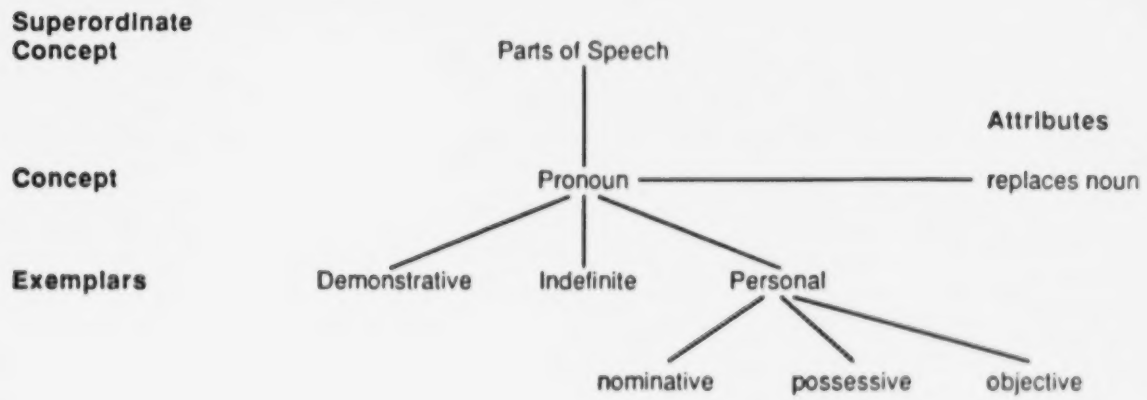

Figure 5
Concept Dimensions Strategy

Developmental Teaching Strategies: Cognitive Skills

The Developmental Teaching program actively engages students by requiring them to think, to look for patterns, and to apply criteria to determine whether or not an example demonstrates a particular concept. Instead of learning a formula in mathematics, for instance, students learn a principle. Rather than memorizing a symbolic sentence (e.g., area = length x width), they learn a verbal proposition (e.g., the area of a rectangle is equal to the product of its length and its width). Such a proposition describes why students go through certain arithmetic steps to solve a problem.

The performance component of this program, which involves active learning, includes those strategies that are designed to teach cognitive skills. After they are able to describe the concept, students use the concept in practice and application tasks. Continued use of the concept results in what Fulton (1986) calls a new intellectual skill. This skill forms the basis for further learning and mastery of new concepts.

The Developmental Teaching program uses thinking tasks to ensure that students master academic concepts and cognitive skills. According to Fulton (1986), this mastery process involves students in high-level thinking that is both active and intentional. When students engage in the full range of activities that characterize this type of thinking, they know their goal, perform a specific task, state a description of the content, use the concept as a learning strategy, and produce new knowledge. Because the academic concept provides a learning strategy for accomplishing a set of related tasks, it facilitates the transfer of learning.

Fulton's taxonomy of cognitive processes. According to Fulton, a thinking task is a combination of the concept and a thinking process. She describes two kinds of conceptual thinking tasks: practice and application. Both use the process of distinguishing attributes and examples of the concept as the strategy for completing the task. Practice tasks do not require high-level thinking, although, in Fulton's view, application tasks do (cf. Bloom, 1956).

According to the taxonomy of the Developmental Teaching program, there are four basic types of thinking processes:

- **Conceptual thinking**—using this process, students master the description of a concept so well that they are able to use it as a learning strategy.
- **Comparison processes**—these processes include sequencing, inferring, classifying, analyzing, and drawing analogies.
- **Transformation processes**—these processes use concepts in new ways for creative production, reasoning, and problem-solving.
- **Evaluative thinking**—these processes are used in decisionmaking.

In conceptual thinking, the description (concept) becomes the learning strategy. There are two types of conceptual thinking: functional and formal. Functional thinking is not usually considered a high-level process because students are not required to produce new knowledge. This type of thinking is not reflective, and usually serves an adaptive function outside of the classroom. Formal thinking is based on the intentional use of distinguishing attributes. Usually it occurs in the classroom setting when a student is required to identify or use a concept.

Practice tasks for conceptual thinking include identifying examples, (e.g., circle all the compound sentences), identifying parts of examples, putting parts of examples together, and working problems. Application tasks produce new knowledge and are high level. Application tasks for conceptual thinking include generating examples of the concept and making up problems that require use of the concept.

In comparison processes, the concept is matched to another concept. The six comparison processes are based on similarities among concepts. Students can make comparisons by sequencing examples from small to large, from beginning to end, and so on according to various attributes. Another comparison process, classification, requires students to group things by their attributes, such as their shapes, sizes, uses, or colors. Categories can be formed on the basis of one defining attribute. Inference is another comparison process; it requires students to produce new knowledge by drawing conclusions from existing knowledge. The process of forming analogies requires students to point out the similarity or similarities between two apparently different things. Analysis requires separating a concept into its parts, its components, or its relationships and naming them.

In transformation processes, students change the description or concept so that it can be used for a specific purpose. There are two transformation processes: creativity and problem-solving. Creativity results in new and original models. Problem-solving does not necessarily produce new knowledge, but it does produce a new application of existing knowledge.

Evaluation processes require students to consider applications of the concept and make judgments about them. These judgments are a form of new knowledge that can be applied to future problems.

Procedures for teaching cognitive skills. The thinking process is taught through steps similar to those used for teaching concepts. A visual schema is presented for each thinking process just as it is for academic concepts.

There are two kinds of thinking tasks: practice tasks and application tasks. In practice tasks, teachers give the examples, and students use the distinguishing attributes to: identify examples of the concept, identify parts of examples, put the parts of examples together, or work the problems. This step is equivalent to the guided practice phase of direct instruction.

Another type of task used for guided practice is the application task. This type requires students to use the distinguishing attributes of a concept to: generate examples, identify the features of their examples, or generate problems requiring application of the concept.

Several teaching techniques are used during practice and application. One of these is guided recall, a procedure in

which the teacher asks students to describe the concept verbally as they are trying to complete a thinking task. The students state the parts or subskills of the concept used as their strategy in the thinking tasks. If the concept does not have subcomponents, students name the distinguishing attributes of the concept. If students need assistance, the teacher names the concept, or reviews the distinguishing attributes and examples, and directs students to write or recite the description of the concept so they can use it as their task strategy.

Assessment of mastery. In the Developmental Teaching program, assessment is undertaken to determine if students know a precise description of the concept and if they can use it as a learning strategy. The mastery test consists of naming the concept, recalling the distinguishing attributes, and using them as the strategy to identify new examples of the concept or to generate new examples.

In the Developmental Teaching program, mastery of the concept is developed by changing the description into a learning strategy (i.e., applying it). Application of the strategy strengthens the likelihood that the concept will be appropriately transferred to problems that are different from those studied in class.

ISSUES TO BE RESOLVED

Although the Developmental Teaching program appears to be highly effective, two major issues have yet to be resolved through research. One involves the program's effectiveness in teaching cognitive skills. The program is designed to teach cognitive skills, as well as basic academic skills, but no controlled studies have been conducted to determine whether students who participate in the program make greater gains in cognitive skills than do students who have not participated in the program. The other issue that still needs to be resolved is whether this program is as effective with high-achieving students as other well researched instructional methods.

Cognitive skills. It has yet to be demonstrated that cognitive skills are taught more effectively through this program than through more typical instructional methods. Offering guidelines to teachers who want to become more effective in teaching thinking, problem-solving, and other higher-order cognitive skills, Levine (1988) points out that such efforts will require "mediated learning" and more active learning experiences for the students. These conditions suggest that teachers will need to have manageable class sizes, so they can provide specific instructions and guidance to low-achieving students. Levine (1988) contends that success in this endeavor will require fundamental, pervasive improvements in schools and classrooms. The Developmental Teaching program attempts to improve students' cognitive skills, but it does not address the issues identified by Levine.

If the goal of improving cognitive skills is important to educators who adopt the program, they will need to identify evaluation instruments that are valid measures of the skills. Such instruments will need to measure students' performance of comparison, transformation, and evaluation processes. Although the number of tests available to assess mastery of cognitive skills has increased substantially over the past decade, the validity of these instruments tends to be much lower than that of standardized tests designed to measure academic achievement (Morante and Ulesky, 1984). This lack of validity is due, in part, to the open-endedness of many of the items on tests designed to assess cognitive skills.

High achievers. Many teachers who have used the Developmental Teaching program advocate its use as a means of instructing all types of students, including high achievers, in the regular classroom. The available research on this program, however, suggests that although it does improve the academic skills of low and average achievers, it may not provide comparable benefits to high achievers.

Grouping is a strategy of proven benefit to high achievers. Low achievers, by contrast, are not well served by ability grouping. Such students tend to achieve even less well in homogeneous classrooms than they do in heterogeneous classrooms (Kulik and Kulik, 1982). For low achievers, this program may be a much needed alternative to ability grouping.

Since high achievers tend to achieve at higher levels in homogeneous classrooms, they may not derive particular benefit from any strategy that is delivered in the regular, heterogeneous classroom (Howley, Howley, and Pendarvis, 1986). Although the Developmental Teaching program advocates heterogeneity in classrooms, it has not substantiated this recommendation with respect to high achievers. In fact, some studies seem to indicate that high achievers make smaller gains than low achievers when this program is employed (Lowrey, personal communication, May 1988).

Kulik and Kulik (1984) found acceleration of bright students to be even more effective than grouping. Although the

Developmental Teaching program might be an excellent means of instructing high achievers who have been accelerated or who have been grouped together, to choose it **instead** of one of these methods would most likely be a disservice to bright students.

CONCLUSION

Citizens and professionals alike express pessimism about the educational system's ability to effect substantial improvement in children's achievement; and, indeed, there are many, intractable problems that will require a much greater commitment of attention and funds than schools are likely to receive. One of the major benefits of the Developmental Teaching program is that it demonstrates the impact teachers can have on their students' achievement. Given an understanding of basic principles about students' learning, teachers can follow a sequence of instructional events that dramatically improve students' mastery of academic concepts and cognitive processes.

Although the Developmental Teaching program has not been studied extensively, research conducted to date has been overwhelmingly positive. Additional studies are needed in order to answer specific questions about the program: its effect on students' learning and retention of cognitive skills, its relevance to particular types of students, and its applicability in particular subject areas.

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